



CLIENTE – <i>Client</i> :	Commessa – <i>Job</i>	Unità – <i>Unit</i>				
LOCALITA' – <i>Plant location</i> :	SPC N°					
PROGETTO – <i>Project</i>	Fg. - <i>Sh.</i> 1	di - <i>of</i> 10	Rev.			
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ENERGY TRANSITION REFERENCES

2	General Revision				05/05/2026
1	General Revision				03/06/2025
0	Issued for Comments				20/02/2023
Rev.	Descrizione - <i>Description</i>	Elab. – <i>Prep.'d</i>	Verif. – <i>Chk'd</i>	Appr. – <i>App'd</i>	Data – <i>Date</i>

H ₂ PLANT REFERENCES						
Ref. #	TECHONOLOGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	Blue H ₂ / CO ₂ Capture	ENIPROGETTI	Technical-economic comparison of three different plant configurations for the production of Blue H ₂ from Natural Gas Steam Reforming: 1) CO ₂ removal pre-combustion, 2) CO ₂ removal post-combustion, 3) CO ₂ removal post-combustion + gas heated reformer (GHR). In all case studies, the use of amine solution absorption was considered as a CO ₂ removal technology.	2021	3	Feasibility Study
2	Blue H ₂ / CO ₂ Capture	ENIPROGETTI	Feasibility study for a hydrogen production plant (50,000 Nm ³ /h) using Autothermal Reforming (ATR) with CO ₂ capture by means of ENI's proprietary technology based on the use of ionic liquids.	2020	3	Feasibility Study
3	Blue H ₂ / CO ₂ Capture	ENIPROGETTI	Feasibility study for a hydrogen production plant (50,000 Nm ³ /h) using Steam-Reforming (SMR) with CO ₂ capture by means of ENI's proprietary technology based on the use of ionic liquids.	2021	3	Feasibility Study
4	H ₂	SAPIO	FEED for the construction of two H ₂ compressor stations and two loading bays for 500 bar cylinder trailers. The compression system and loading bays will be powered by H ₂ generated by the plant's existing Steam-Reforming plant.	2022-2023	3	FEED
5	Green H ₂	SAPIO	Green H ₂ compression system and truck trailer loading line	2021	2	Feasibility Study
6	Green H ₂ / CO ₂ Capture / PtX	CONSORZIO HYBLA	Feasibility study for a Green Syngas production plant, obtained from H ₂ produced via electrolysis and CO produced by CO ₂ electrolysis. The plant includes a Carbon Capture unit to capture 5,000 kg/h of CO ₂ from a factory's flue gases.	2022-2023	3	Feasibility Study
7	Green H ₂ / PtX	SNAM	Construction of a pilot plant for the production and injection of hydrogen into the natural gas grid, to be installed at reduction station No. 818 in Contursi Terme (SA). The plant's purpose is to introduce a quantity of hydrogen into the grid up to a blending level of less than 10% vol., on an experimental basis and for a limited period of operation, with periodic reporting of the results. The plant includes a hydrogen production electrolyzer with a capacity of 20 Sm ³ /h (114 kW), powered by electricity from the on-site photovoltaic system or, alternatively, from the national electricity grid if the energy produced by the photovoltaic system is insufficient. The hydrogen produced is fed to a buffer that will ensure stable operation for the compressor. The hydrogen is then compressed and injected into the grid or stored in cylinders to provide a reserve when the photovoltaic system, and consequently the electrolyzer, is unable to produce sufficient hydrogen to meet grid demand.	2024-2025	8	Detailed Engineering
8	Green H ₂ / PtX	SNAM / Hera	FEED for Hydrogen Valley Modena	2023-2024	5	FEED
9	Green H ₂ / PtX	SNAM	Feasibility study for a green H ₂ production, compression, and storage plant and a natural gas blending system to feed an industrial furnace.	2022	3	Feasibility Study
10	Green H ₂ / PtX / PV / Energy Storage	SNAM	Feasibility study for a 10 MWe Green H ₂ plant and H ₂ compression, storage, and loading line onto cylinder trailers. The study considered upstream integration with a 30 MWe photovoltaic system and a battery-powered energy storage system (BESS).	2022	3	Feasibility Study
11	Green H ₂ / PtX	SNAM	Hydrogen Valley Piemonte - H ₂ production plant through electrolysis (6 MW), compression, storage and loading bays for hydrogen distribution via trailers.	2022	3	Feasibility Study
12	Green H ₂ / PV	SNAM	Feasibility study for an electric power generation system using a fuel cell powered by green hydrogen, integrated with a photovoltaic system, to be installed aboard a racing yacht (Zero Emission Trimaran). The aim is to replace the fossil fuels (diesel engine) currently used to power onboard services with renewable sources. Focus: component selection, layout development, and preliminary safety study.	2022	2	Feasibility Study
13	Green H ₂ / PtX	SGI (Società Gasdotti Italia)	Feasibility study of the compression, storage, and blending sections of a green hydrogen production plant. This hydrogen, blended with natural gas, will be distributed via pipeline to several industrial users in the Frosinone (FR) district, currently served by SGI.	2022	1	Feasibility Study
14	H ₂ / Waste to H ₂ / Waste to Fuel	ENIPROGETTI	Cold Eye Review of the Basic Design Package developed by the technology licensor (NextChem).	2020	4	Technological Consulting
15	H ₂ "Turchese"	ENI	Basic design for a pilot plant for the production of H ₂ by catalytic pyrolysis of natural gas	2025	6	Basic Design
16	H ₂	ENI	PMC services and BOP engineering services for the supply of a package plant for the production of 1500 Nm ³ /h of high-purity H ₂ from steam reforming of natural gas.	2022	6	PMC Services
17	H ₂	ENI	Advanced basic design (FEED) for a new H ₂ production plant (6000 Nm ³ /h) from natural gas using Eni's proprietary SCT-CPO (Short Contact Time - Catalytic Partial Oxydation) technology.	2012	5	FEED
18	Green H ₂ / PV / Energy Storage / Carbon Capture / PtX / E-fuels	Raffineria di Milazzo	Green Methanol production plant consisting of: 1) photovoltaic system (190 MW) with battery storage of electricity (38 MW BESS); 2) Green H ₂ production plant (550 kg/h); 3) CO ₂ capture plant (4100 kg/h) from the flue gases of one of the refinery's stacks; 4) Green Methanol production plant (2700 kg/h) by direct hydrogenation of the captured CO ₂ .	2020	2	Feasibility Study
19	PtX / Energy Storage	ENIPOWER	The study analyzed the possibility of using the electricity generated at low or zero value by Enipower's combined-cycle power plants (i.e., lost energy produced by the plants at times when there is no demand on the grid) to produce hydrogen through electrolysis (reference electrolyzer capacity: 80 MWe). The hydrogen produced could be fed into the national gas grid, in a percentage compatible with the metallurgy of the lines and the Wobbe index specification for NG, creating a form of storage for unusable electricity.	2019	3	Feasibility Study
20	H ₂ / PtX / Bioplastics	MATRICA	FEED (Front End Engineering Design) for the new pelagomic acid (PEA) hydrogenation unit at the bio-sourced monomers production plant for bioplastics in Porto Torres (SS). The hydrogenation unit includes an electrolyzer for the production of high-purity hydrogen (>99.99%) for use in the reaction.	2021	6	FEED
21	H2 / SNG / Green Ammonia	ENI	Technical and economical study transportation over long distances of Substitute Natural Gas and Ammonia, considered as carriers of green hydrogen produced at low-cost at specific locations. The study focused on the following components of the value chain: •Liquefaction plant and cryogenic storage system at the production site •Carrier loading/unloading system •Characteristics of the carriers (i.e. ship, truck) •System for receiving, storage, regassification/cracking at the delivery site	2026	4	Feasibility Study

CO ₂ CAPTURE PLANT REFERENCES						
Ref. #	TECHONOLOGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	CO ₂ Capture	SAIPEM / ENI	FEED for a 10 TPD capacity CO ₂ capture plant based on Bluenzyme/CO ₂ Solution technology.	2025	5	FEED
2	CO ₂ Capture	SAIPEM / ENI	FEED for a 50 TPD capacity CO ₂ capture plant based on Bluenzyme/CO ₂ Solution technology.	2024	5	FEED
3	CO ₂ Capture	DANIELI FAR EAST	Detailed engineering and procurement services for a 10,000 Nm ³ /h CO ₂ capture plant using Giammarco-Vetrocoke Hot Potassium Carbonate technology.	2012	8	Detailed Engineering
4	CO ₂ Capture	ENI	Feasibility study for a plant for the capture of 300 MTPD of high-purity CO ₂ by scrubbing the syngas stream produced by the Sannazzaro refinery's Steam-Reforming plant. The following CO ₂ capture technologies were compared: Giammarco-Vetrocoke Hot Potassium Carbonate Dual Activated Solution (chemical absorption with activated carbonate solution); Membrane Technology Research (separation with selective membranes); UOP Amine Guard FS (chemical scrubbing with an activated MDEA-based amine solution).	2020	3	Feasibility Study
5	CO ₂ Capture / Blue H ₂	ENIPROGETTI	Technical and economic comparison of three different plant configurations for the production of Blue H ₂ from natural gas steam reforming: 1) CO ₂ removal pre-combustion, 2) CO ₂ removal post-combustion, 3) CO ₂ removal post-combustion + gas heated reformer (GHR). In all case studies, chemical scrubbing with amines was considered as the CO ₂ removal technology.	2021	3	Feasibility Study
6	CO ₂ Capture / Blue H ₂	ENIPROGETTI	Feasibility study for a hydrogen production plant (50,000 Nm ³ /h) using Autothermal Reforming (ATR) with CO ₂ capture using ENI's proprietary technology based on the use of ionic liquids.	2020	3	Feasibility Study
7	CO ₂ Capture / Blue H ₂	ENIPROGETTI	Feasibility study for a hydrogen production plant (50,000 Nm ³ /h) using Steam-Reforming (SMR) with CO ₂ capture using ENI's proprietary technology based on the use of ionic liquids.	2021	3	Feasibility Study
8	Green H ₂ / PV / Energy Storage / Carbon Capture / PtX / E-fuels	Raffineria di Milazzo	Green Methanol production plant consisting of: 1) photovoltaic system (190 MW) with battery storage of electricity (38 MW BESS); 2) Green H ₂ production plant (550 kg/h); 3) CO ₂ capture plant (4100 kg/h) from the flue gases of one of the refinery's stacks; 4) Green Methanol production plant (2700 kg/h) by direct hydrogenation of the captured CO ₂ .	2020	2	Feasibility Study
9	Green H ₂ / CO ₂ Capture / PtX	CONSORZIO HYBLA	Feasibility study for a Green Syngas production plant, obtained from H ₂ produced by electrolysis and CO produced by CO ₂ electrolysis. The plant includes a Carbon Capture unit for capturing 5,000 kg/h of CO ₂ from plant flue gases. Two CO ₂ capture technologies were compared: UOP Advanced Solvent Carbon Capture and SAIPEM CO ₂ Solutions (enzyme-promoted carbonates).	2022-2023	3	Feasibility Study
10	PtX / Green H ₂ / CO ₂ Capture	ENIPROGETTI	Comparison and selection of the Licensor for the supply of license and basic of the methanation section of the plant for the production of SNG (Substitute Natural Gas) starting from CO ₂ from a carbon capture plant (5000 kg/h) and Green H ₂ .	2022	3	Technological Consulting
11	PtX / Green H ₂ / CO ₂ Capture	ENIPROGETTI	Feasibility study for a Demo Plant and Semi-Industrial Plant for the production of Substitute Natural Gas (SNG) from CO ₂ obtained from a carbon capture plant and hydrogen produced by electrolysis. The electrolyzer capacity is 2 MWe for the Demo Plant and 48 MWe for the Semi-Industrial Plant. The amount of CO ₂ converted into SNG is 200 kg/h for the Demo Plant and 5,000 kg/h (40,000 MTPY) for the Semi-Industrial Plant.	2021-20	3	Pre-Feasibility & Feasibility Study
12	Biogas / Biometano / CO ₂ Capture / PtX / E-fuels	ENIPROGETTI	Feasibility study for the production of Green Methanol (90 MTPD) starting from syngas produced from biogas from OFMSW and from H ₂ produced by electrolysis (24 MWe) powered by renewable EE, through Eni's proprietary SCT-CPO (Short Contact Time - Catalytic Partial Oxidation) technology which allows the production of syngas with a composition suitable for methanol synthesis using all the CO ₂ contained in the biogas.	2019	3	Feasibility Study

POWER TO X / E-FUELS REFERENCES						
Ref. #	TECHONOLGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	PtX	SASOL	Feasibility study for the electrification of the n-paraffin production process. The project's main objectives are to reduce CO ₂ emissions and the cost of producing n-paraffin. The project involves the installation of new electrical exchangers—powered by electricity generated by a PV system—to replace the existing process heat exchangers and the revamping of the n-paraffin production plant, replacing numerous pieces of equipment with new, more efficient ones to reduce consumption and production costs.	2023-2024	6	Feasibility Study
2	e-fuels (e-SAF)	SARLUX	Pilot plant - based on NEXTCHEM / INERATEC technology - for the production of Sustainable Aviation Fuel from H ₂ and CO ₂ .	2023-2025	24	Feasibility Study + FEED + Detailed Engineering
3	Green H ₂ / CO ₂ Capture / PtX	CONSORZIO HYBLA	Feasibility study for a Green Syngas production plant, obtained from H ₂ produced via electrolysis and CO produced by CO ₂ electrolysis. The plant includes a Carbon Capture unit for capturing 5,000 kg/h of CO ₂ from a plant's flue gases. Two CO ₂ capture technologies were compared: UOP Advanced Solvent Carbon Capture (ASCC) and SAIPEM / CO ₂ Solutions (enzyme-promoted potassium carbonates).	2022-2023	6	Feasibility Study
4	PtX	SGI (Società Gasdotti Italia)	Feasibility study of the compression, storage, and blending sections of a green hydrogen production plant. This hydrogen, blended with natural gas, will be distributed via pipeline to several industrial users in the Frosinone (FR) district, currently served by SGI.	2022	2	Feasibility Study
5	Green H ₂ / PtX	SNAM	Feasibility study for a green H ₂ production, compression, and storage plant and a natural gas blending system to power an industrial furnace.	2022	3	Feasibility Study
6	Green H ₂ / PtX / PV / Energy Storage	SNAM	Feasibility study for a 10 MWe Green H ₂ plant and H ₂ compression, storage, and loading line onto cylinder trailers. The study considered upstream integration with a 30 MWe photovoltaic system and a battery-powered energy storage system (BESS).	2022	3	Feasibility Study
7	Green H ₂ / PtX	SNAM	Hydrogen Valley Piemonte - H ₂ production plant through electrolysis, compression, storage and loading bays for hydrogen distribution via trailers.	2022	3	Feasibility Study
8	Green H ₂ / PtX / PV	SNAM	Feasibility study for an electric power generation system using a fuel cell powered by green hydrogen, integrated with a photovoltaic system, to be installed aboard a racing yacht (Zero Emission Trimaran). The aim is to replace the fossil fuels (diesel engine) currently used to power onboard services with renewable sources. Focus: component selection, layout development, and preliminary safety study.	2022	2	Feasibility Study
9	PtX	SAPIO	Green H ₂ compression system and loading line on cylinder trailers.	2021	2	Feasibility Study
10	PtX / Energy Storage	ENIPOWER	The study analyzed the possibility of using the electricity generated at low or zero value by Enipower's combined-cycle power plants (i.e., lost energy produced by the plants at times when there is no demand on the grid) to produce hydrogen through electrolysis (reference electrolyzer capacity: 80 MWe). The hydrogen produced could be fed into the national gas grid at a percentage compatible with the metallurgy of the lines and the Wobbe index specification for NG, creating a form of storage for the fatally generated electricity.	2019	3	Feasibility Study
11	PtX / Green H ₂ / CO ₂ Capture	ENIPROGETTI	Technology comparison and licensor selection for the licensing and basic design of the methanation section of the plant for the production of SNG (Substitute Natural Gas) from CO ₂ from a carbon capture process (5000 kg/h) and Green H ₂ . The methanation technologies analyzed were TOPSOE's TREMP and WOOD's VESTA.	2022	3	Technological Consulting
12	PtX / Green H ₂ / CO ₂ Capture	ENIPROGETTI	Feasibility study for a Demo Plant and Semi-Industrial Plant for the production of Substitute Natural Gas (SNG) from CO ₂ obtained from a carbon capture plant and hydrogen produced by electrolysis. The electrolyzer capacity is 2 MWe for the Demo Plant and 48 MWe for the Semi-Industrial Plant. The amount of CO ₂ converted into SNG is 200 kg/h for the Demo Plant and 5,000 kg/h (40,000 MTPY) for the Semi-Industrial Plant.	2020-2021	3	Pre-Feasibility & Feasibility Study
13	PtX / E- fuels	POLENERGIA	Feasibility study for the production of eJetFuel from H ₂ produced by electrolysis and CO ₂ from a carbon capture plant. The study analyzed the production of jet fuel from H ₂ and CO ₂ via Reverse Water Gas Shift + Fischer-Tropsch synthesis, with the production route via methanol synthesis by direct hydrogenation of CO ₂ , production of light olefins via the MTO (Methanol to Olefins) process, and oligomerization of light olefins to kerosene (jet fuel).	2022-2023	4	Feasibility Study
14	PtX / E-Fuels	ENI	Technical and economic comparison of different eFuel production alternatives. The study analyzed the production costs of the following e-fuels with their corresponding fossil fuels: Substitute Natural Gas, e-Methanol, and e-Jet Fuel.	2023-2024	6	Feasibility Study
15	Biogas / Biomethane / CO ₂ Capture / PtX / E-fuels	ENIPROGETTI	Feasibility study for the production of Green Methanol (90 MTPD) starting from syngas produced from biogas from OFMSW and from H ₂ produced by electrolysis (24 MWe) powered by renewable EE, through Eni's proprietary SCT-CPO (Short Contact Time - Catalytic Partial Oxidation) technology which allows the production of syngas with a composition suitable for methanol synthesis using all the CO ₂ contained in the biogas.	2019	3	Feasibility Study

REFERENCES FOR BIOGAS AND BIOMETHANE PLANTS

Ref. #	TECHONOLGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	Waste to Fuel	CARBOREM / GREENTHESIS	The hydrothermal carbonization (HTC) process of sewage sludge developed by Carborem is a thermo-chemical process that treats the sludge at 190°C and approximately 14-15 bar inside a pressure vessel. The HTC process promotes the solubilization of the organic matter of the sludge in the liquid fraction and disintegrates the walls of the sludge cells (flocks), converting the “bound” water inside the sludge cells into “free” water. This process of breaking down the sludge structure promotes the separation of water from the sludge itself through dehydration with a centrifuge or filter press and allows for higher post-dehydration dry matter contents to be achieved. During the process, vapours are generated which are partially cooled and condensed. The non-condensable fraction is a gas, which is produced in negligible quantities and consists of approximately 85-90% carbon dioxide. The amount of gas produced is approximately 5% of the dry matter of the incoming sludge. The HTC liquid (HTCL) obtained from the dewatering of the sludge treated by HTC (HTC slurry) has COD contents usually between 10 and 20 g/l, and is a good substrate for the production of biogas. The HTC solid obtained after dehydration (hydrochar) is a sterilized material free from pathogens (such as Escherichia coli and Salmonella), which can be used for other purposes (e.g. as a filler for the production of packaging cardboard, as a solid biofuel for the production of hydrogen/energy, as a substrate for the production of fertilizer, or as a substrate for the extraction of phosphorus for the production of struvite/phosphates).	2022-2023	6	Detailed Engineering
2	Biogas / Biomethane / Green H ₂ / PtX / E-fuels	ENIPROGETTI	Feasibility study for the production of Green Methanol (90 MTPD) starting from syngas produced from biogas from OFMSW and from H ₂ produced by electrolysis (24 MWe) powered by renewable EE, through Eni's proprietary SCT-CPO (Short Contact Time - Catalytic Partial Oxidation) technology which allows the production of syngas with a composition suitable for methanol synthesis using all the CO ₂ contained in the biogas.	2019	3	Feasibility Study
3	Biogas / Biomethane / Green H ₂ / PtX / E-fuels	VERSALIS	A plant for upgrading 12,000 Nm ³ /day of biogas produced from the wastewater of the Crescentino (VC) bioethanol production plant to biomethane. The study analyzed three different upgrading technologies: membranes, PSA, and cryogenics. The selected upgrading technology was membranes.	2020	6	FEED

BIO-FUELS, BIOPLASTICS, BIOMASS ENERGY REFERENCES						
Ref. #	TECHONOLGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	Bio-fuels	Q8	Basic engineering for the logistical reorganization of the Napoli tank farm, following the introduction of bioethanol as a gasoline additive.	2023	4	Basic Design
2	Bio-fuels	TAMOIL	Basic engineering for the logistical reorganization of the Trecate tank farm following the introduction of bioethanol as a gasoline additive.	2023	4	Basic Design
3	Bio-fuels	TAMOIL	Feasibility study to modify the current heating diesel oil circuit to receive, store and load Jet Fuel at the Cremona depot	2023	2	Feasibility Study
4	Bio-fuels	ENI	Basic engineering for the logistical reorganization of the Venice Refinery tank farm following the introduction of new biological feedstocks to be fed to the HVO Ecofining plant.	2021	5	Basic Design
5	Bio-fuels	Raffineria di Milazzo	Feasibility study for adapting the existing logistics to the use of biomass feedstocks.	2025-in progress	3	Feasibility Study
6	Bio-fuels	Raffineria di Milazzo	Co-feeding system for vegetable oils to the refinery's hydrotreating plant.	2021-2022	8	Basic + Detailed Engineering
7	Bio-fuels	ENI	Process study to estimate the production yields of renewable fuels through the co-processing of bio-based raw materials, with specific reference to Cashew Nutshell Liquid, at the FCC unit of the Sannazzaro Refinery.	2023	2	Feasibility Study
8	Bio-fuels	ENI	Feasibility study for a new washing section dedicated to pre-treatment of waste vegetable oils such as UCO (Used Cooking Oil) and similar, in order to remove contaminants harmful to the HVO (Ecofining) plant catalyst and thus increase the plant's flexibility with regard to feedstocks.	2019	3	Feasibility Study
9	Bio-fuels / Waste to Fuel	SARLUX	The project concerns the installation of the pre-treatment plant (PTU) based on ALFA LAVAL technology to make the biological feedstocks UCO (Used Cooking Oil) and POME (Palm Oil Mill Effluent) suitable for co-feeding to one of the refinery's gasoil hydrotreating plants.	2024-in progress	9	Detailed Engineering
10	Bio-fuels / Waste to Fuel	SARLUX	The study defined the plant configuration to make the biological feedstocks UCO (Used Cooking Oil) and POME (Palm Oil Mill Effluent) suitable for co-feeding to one of the refinery's diesel oil hydrotreating plants.	2021	3	Feasibility Study
11	Bio-fuels	ENI	FEED (with cost estimate +/- 15%) to identify the modifications required to the current asset of the interconnection between unit 26 (HF ₂) and the tank farm in anticipation of the new asset relating to the Biojet Production project.	2025 - in progress	5	FEED
12	Bio-fuels	ENI	Process study for biojet production at the Livorno Refinery. The study analyzed the feasibility of using an existing idle separation train at the refinery to produce BioJet from biodiesel and bionaphtha cuts produced at the HVO plants (ECOFINING) at Gela and Venice biorefineries.	2021	2	Process Study
13	Bio-fuels	Raffineria di Gela	Project for the installation of new loading arms and pipelines razionalisation on the refinery jetty for the purpose of reception and dispatch of biofuels.	2025-in progress	6	FEED
13	Bio-fuels	Raffineria di Gela	Study for the debottlenecking of the gas recovery unit of the ECOFINING plant to enable BioJet production. STEP 1 (simulation model implementation), STEP 2 (current running configuration simulation), STEP 3 (future setup verification).	2021	8	Process Study
14	Bio-fuels	PKN ORLEN	Technical Advisory Services for the selection of the technology licensor for the new 350,000 MTPY Hydrotreated Vegetable Oil (HVO) production plant at the Plock refinery (Poland). The services consisted of a comparative evaluation of the License and Basic offers for the new plant submitted by various licensors.	2019	3	Technological Consulting
15	Bio-fuels / Waste to Fuel	ENIPROGETTI	Consolidation of the basic design and FEED for a plant based on Eni's proprietary W2F technology for the production of biofuel through the thermo-liquefaction of 150 ktpy of Organic Fraction of Municipal Solid Waste. The scope of work also included preparation of the required permitting documentation (PAUR).	2020-2021	12	FEED
16	Bioplastics	BIO-ON	Basic design for n.2 plants for the production of polyhydroxyalkanoates (PHA) from molasses and glycerol.	2016	6	Basic Design
17	Bioplastics	MATRICA	Advanced basic engineering to improve the performance of the units U-2100 (hydroxylation) and U-2200 (oxidative cleavage) sections of the Porto Torres (SS) bio-monomer production plant.	2018-2019	6	FEED
18	Bioplastics	MATRICA	FEED for the new bio-monomer (azelaic acid) granulation unit at the Porto Torres (SS) plant.	2020	4	FEED
19	PtX / Green H ₂ / Bioplastics	MATRICA	FEED for the new pelagornic acid (PEA) hydrogenation unit. The hydrogenation unit includes an electrolyzer for the production of high-purity hydrogen (>99.99%).	2021	6	FEED
20	Biomass Energy	MAIRE ENGINEERING	Basic design for a 17 MWe biomass-fired power plant (wood chips) at Olevano Lomellina (PV)	2008	4	Basic Design
21	Biomass Energy	SIRAM	Conceptual Design and cost estimate for 2 biomass-fired(wood chips) power plants: Coniolo (10 MWe), Augusta (14 MWe)	2009	4	Conceptual Design

ENERGY STORAGE SYSTEMS REFERENCES

Ref. #	TECHONOLGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	Energy Storage	AXPO	Detailed engineering for the installation of an EE storage system using batteries (BESS) with a capacity of 45 MWh and a nominal power of 9.9 MW.	2025 - in progress	6	FEED + Detailed Engineering
2	PV / Energy Storage / Green H ₂ / PtX	SNAM	Feasibility study for a 10 MWe Green H ₂ plant and H ₂ compression, storage and loading line on high pressure tank trailers. The study considered upstream integration with a 30 MWe photovoltaic plant and a battery EE storage system (BESS).	2022	3	Feasibility Study
2	Green H ₂ / PV / Energy Storage / Carbon Capture / PtX / E-fuels	Raffineria di Milazzo	Green Methanol production plant consisting of: 1) photovoltaic system (190 MW) with battery storage of EE (38 MW BESS); 2) Green H ₂ production plant (550 kg/h); 3) CO ₂ capture plant (4100 kg/h) from the flue gases of one of the refinery's stacks; 4) Green Methanol production plant (2700 kg/h) by direct hydrogenation of the captured CO ₂ .	2020	2	Feasibility Study
3	PtX / Energy Storage	ENIPOWER	The study analyzed the possibility of using the electricity generated at low or zero value by Enipower's combined-cycle power plants (i.e. lost energy produced by the plants when there is no demand on the grid) to produce hydrogen through electrolysis (electrolyzer capacity: 80 MWe). The hydrogen produced could be fed into the national gas grid, in a percentage compatible with the metallurgy of the lines and the Wobbe index specification for NG, acting as a storage for stranded electricity.	2019	3	Feasibility Study
4	Energy Storage	ENIPOWER	Feasibility study for an energy storage system with a cement-based thermal accumulation system (HEATCRETE Energy Nest technology) and CAPEX/OPEX comparison with a molten salts storage system. The study considered the Ferrera Erbognone and Ravenna power plants.	2020	6	Feasibility Study
5	Energy Storage	ENIPOWER	Updated study for Ferrera Erbognone and Ravenna using a rock-based thermal storage technology (Brenmiller technology) and extension of the study to Brindisi and Ferrara power plants.	2021	10	Feasibility Study

CIRCULAR ECONOMY REFERENCES						
Ref. #	TECHONOLOGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	Waste to Fuel / Biogas	CARBOREM / GREENTHESIS	The hydrothermal carbonization (HTC) process of sewage sludge developed by Carborem is a thermo-chemical process that treats the sludge at 190°C and approximately 14-15 bar inside a pressure vessel. The HTC process promotes the solubilization of the organic matter of the sludge in the liquid fraction and disintegrates the walls of the sludge cells (flocks), converting the “bound” water inside the sludge cells into “free” water. The process of breaking down the sludge structure promotes the separation of water from the sludge through dehydration (with a centrifuge or filter press) resulting in higher post-dehydration dry matter contents. During the process, vapours are generated which are partially cooled and condensed. The negligible non-condensable fraction (approximately 5% of the dry matter of the incoming sludge) is a gas consisting of approximately 85-90% carbon dioxide. The HTC liquid (HTCL) obtained from the dewatering of the sludge treated by HTC (HTC slurry) has COD contents in the 10-20 g/l range and is a good substrate for the production of biogas. The HTC solid obtained after dehydration (hydrochar) is a sterilized material free from pathogens (such as Escherichia coli and Salmonella), which can be used for various purposes (e.g. as a filler for the production of packaging cardboard, as a solid biofuel for the production of hydrogen/energy, as a substrate for the production of fertilizer, or as a substrate for the extraction of phosphorus for the production of struvite/phosphates).	2022	6	Detailed Engineering
2	H ₂ / Waste to Hydrogen / Wast to Fuel	ENIPROGETTI	Cold Eye Review of the Basic Design Package developed by the technology licensor (NextChem).	2020	4	Technical Consulting
3	Biofuels / Waste to Fuel	ENIPROGETTI	Consolidation of the basic design and FEED of the plant based on Eni's proprietary W2F technology for the production of bio-fuel by thermo-liquefaction of 150 ktpy of OFMSW. The scope of work also included the preparation of documentation for permitting (PAUR).	2020-2021	12	FEED
4	Biofuels / Waste to Fuel	SARLUX	The study defined the plant configuration to make the biological feedstocks UCO (Used Cooking Oil) and POME (Palm Oil Mill Effluent) suitable for co-feeding to one of the refinery's diesel hydrotreating plants.	2021	3	Feasibility Study
5	Recycling of spent catalysts	ORLEN POLUDNIE	The feasibility study compared available technologies for recovering Ni, V, and Co from spent catalysts produced at ORLEN refineries hydroconversion plants and provided recommendations for selecting the most suitable technology. The study also assessed the optimal plant capacity and location. Two clients sites were compared: Trzebinia and Jedlicze (Poland).	2020	3	Feasibility Study

PHOTOVOLTAIC SYSTEM REFERENCES

Ref. #	TECHONOLOGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	PV / Energy Storage / Green H ₂ / PtX	SNAM	Feasibility study for a 10 MWe Green H ₂ plant and H ₂ compression, storage and loading line on high pressure tank trailers. The study considered upstream integration with a 30 MWe photovoltaic plant and a battery EE storage system (BESS).	2022	3	Feasibility Study
2	PV / Green H ₂ / PtX	SNAM	Feasibility study for an EE generation system using a Fuel Cell powered by green hydrogen, integrated with a photovoltaic system, to be installed on board a racing boat (Zero Emission Trimaran) with the aim of replacing the fossil fuels (diesel engine) currently used to power on-board services with renewable sources. Focus: component selection, layout development, preliminary safety study.	2022	2	Feasibility Study
3	PV / Energy Storage / CO ₂ Capture / Green H ₂ / PtX / E-fuels	Raffineria di Milazzo	Green Methanol production plant consisting of: 1) photovoltaic plant (190 MW) with EE storage by batteries (BESS 38 MW); 2) Green H ₂ production plant (550 kg/h); 3) CO ₂ capture plant (4100 kg/h) from the flue gases of one of the refinery's stacks; 4) Green Methanol production plant (2700 kg/h) by direct hydrogenation of the captured CO ₂ .	2020	2	Feasibility Study
4	PV	ENIPOWER	Plant consisting of an isolated Power Generation Set for the operation of oil extraction pumps, consisting of a 110 kW photovoltaic plant operating in parallel with a 200 kW diesel generator at Hagiba Oil Field (Egypt).	2012	8	Basic Design
5	PV	ENIPOWER	Electrodynamic study of a photovoltaic power plant, Mellitah (Libya) 2MW Plant capacity	2010	4	Feasibility Study
6	PV	ENIPOWER	1 MW photovoltaic power plant (Taranto, TA). Detailed engineering including preparation of technical specifications for tenders and all the documentation to be submitted to the competent bodies for obtaining permits.	2010	8	Final Design (FEED)
7	PV	ENIPOWER	4.5 MW photovoltaic power plant (Ferrandina, MT). Detailed engineering, including preparation of technical specifications for tendering and all the documentation required to be submitted to d to the statutory authorities for permitting.	2010	8	Final Design (FEED)
8	PV	ENIPOWER	3.4 MW photovoltaic power plant (Navicelli, Pisa) . Detailed engineering, including preparation of technical specifications for tendering and all the documentation to be submitted to the statutory authorities for permitting.	2010	4	Final Design (FEED)
9	PV	ENIPOWER	Photovoltaic systems on n. 26 school rooftops (South Rome). Total capacity: 1 MW	2010	3	FEED
10	PV	ENIPOWER	1 MW photovoltaic power plant (Arezzo)	2010	2	FEED

HYDROELECTRIC POWER PLANTS REFERENCES

Ref. #	TECHONOLGY	CLIENT	SUMMARY	YEAR	PROJECT DURATION [months]	ENGINEERING PHASE
1	Idroelettrico	ENIPROGETTI	Assessment of sites for hydroelectric power generation	2020	2	Feasibility Study
2	EE recovery by turbine on oil pipeline	ENI	The study analyzed the feasibility of generating electricity by installing a hydraulic turbine (reverse-pump) in parallel of the let-down valve at the arrival terminal of the Val d'Agri-Taranto pipeline (136.7 km, from 1300 m to sea level at the Taranto refinery. The addition of drag-reducers to the crude oil was assessed to reduce energy loss due to pressure drops along the pipeline.	2015	2	Feasibility Study